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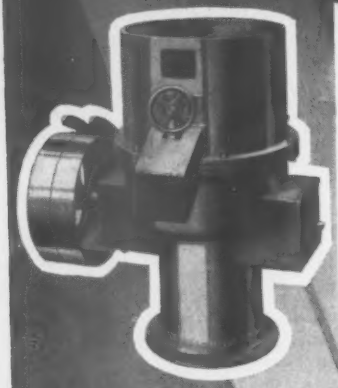

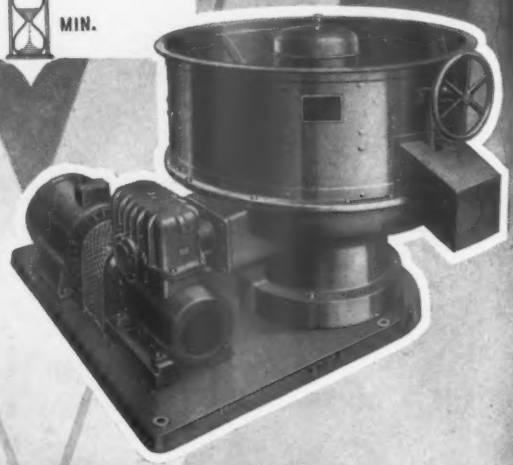

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FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 69 Thursday, February 18, 1943 No. 1383

Design and the Future

We cannot help but believe that foundry executives have permitted war conditions to reinforce the unsound system of selling castings by weight. Surely by now it is realised the cost of a casting is dictated much more by complexity of design and production problems than by its intrinsic weight. Thus one does not sell sash weights at the same price level as Diesel engine cylinders, and any attempt to create a price schedule ranging between these two extremes is a waste of time. It is insufficiently recognised that it is impossible to fix an equitable schedule even for one customer based on a decreasing price with an increasing weight. One very intelligent foundry manager, after much thought, created such a schedule in agreement with the buyer for a firm making lifts and escalators. The very next order, because of weight, entered the lowest price category, but it carried so many cores that its correct position should have been amongst the highest priced castings in the schedule. The buyer of castings, when he passes over to the foundry a set of drawings, a pattern, or a sample, does, on account of design, very largely establish the price, the weight and the speed of delivery. It is thus incumbent upon the industry to teach the buyer that it is not in his firm's interest to seek out hole-and-corner concerns to obtain the lowest price, but to refer back to the designer and drill it into him that every component or engine member featured on his blue-prints will cost his firm a price which will vary according to its complexity as related to foundry requirements. We well remember, when the craze for weldings was rife amongst engineers, that a well-known foundry manager was taunted by his chief because job number 30/XY/4 was now being done by the welders for 8s., whereas as a casting it cost 12s. After inspecting the new design, the foundry manager promptly replied: "Well, if that is the design you really want, you can have it as a casting for 6s." This clearly shows the weakness the foundry industry has exhibited in the past by accepting without question orders from engineers for castings which enter into his high-cost category, when by negotiation they could be, by redesigning, placed in a much deeper one. Mr. E. B. Carpenter has dealt with this subject in an article printed in the December issue of the "American Foundryman," and one of his conclusions is worth quoting: "It is my contention, therefore, that in spite of all the fine publications on casting design, this information has not been utilised to the best advantage. It would be far better for us if we had a concise pamphlet edited, say, by the American Foundrymen's Association, and obtainable at no greater cost than a good cigar, for distribution amongst our own customers than to have our libraries bulging with handbooks that tell us what we already know." Only last week, two foundry executives asked us for suitable material for teaching their designing staff the elements of foundry practice, in order that the blue-prints they received would be of such a character that manufacture would be on the most economical basis. Then we also shared Mr. Carpenter's views, for the existence of such a pamphlet might render unnecessary the teaching of foundry technique to designers. Whilst the production of such a pamphlet is very desirable, much could be done now by all jobbing foundries printing on their quotations an appropriate slogan. One which comes to mind, but which no doubt is capable of improvement, might read: "Prices of castings depend on design. By co-operation with our technical staff a better and cheaper job may result." A designer, thinking of using weldings or plastics into his design, will admit his ignorance and consult the experts, but he very erroneously, though conscientiously, assumes he knows all about castings. This situation needs correction.

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CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

BEDPLATE MOULDING

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—With reference to the column on the production of a bedplate by W.G. in your issue of December 3, the necessity to use a drawback is superfluous. The core at Fig. 2 can easily be lowered into position and centred, provided the job is done properly.

The pattern at the deep section need not be hollowed out for the making of the core. It should be covered in, and the core made in a frame corebox. A core grating should be used, with two lifters cast in to lower the core in position in the mould on top of a flat piece of wood 10 in. by 24 in., the thickness of the metal on the bottom.

A "thickness stick" must be used to centre the core to give even thickness all round. The top part should be lowered on so that the position of the lifters can be marked with chalk on the face of top part. The top part should then be lifted clear and holes drilled in same where chalk shows position of lifters in core. The top should be lowered on the mould and the core bolted to it, by inserting long hook bolts through the holes in the sand to catch the lifters, and tying bolts through fishplates across the top part box bars. This procedure ensures the core being held, and prevents it moving in the cast.

The top part with the core bolted to it should be lifted off, the piece of wood removed, and the thickness checked all round with thickness clays placed on the bottom of the mould, and reaching up the side some 6 in. or 7 in. high. Then lower the top on the mould, and again remove it; any discrepancy found can then be rectified.

The usual practice is to card the core where the metal shows thin, on the clay check. The bolts holding the core may be slackened, however, and a piece of paper (or the required thickness of paper) slipped in between the core and the top to adjust the core to give the desired thickness.

A firm in the north has made many hundreds of similar castings, and this is the method they have used for more than thirty years now, as the job is only ordered in ones and small lots.

I made quite a number myself, as I served my apprenticeship there. The bedplate W.G. referred to can easily be made inside two days by one man.

In your issue of January 28 Mr. T. Smith offers a suggestion how to make the job. But with all due respect I consider the method a waste of man-hours. I admit I am strongly critical where methods are published when said methods are obviously tedious, or redundant.

N.B.—The deep core would do well to be cinder vented, and sand permeable at 125 at least. The gas to be led off at the lifters and up through the bolt holes in the top part.—Yours, etc.,

W. T. BRUCE.

7, Heathfield Avenue, Chesterfield.
February 1, 1943.

X-RAY ANALYSIS IN INDUSTRY

SECOND CAMBRIDGE CONFERENCE

A second conference to promote the interchange of knowledge and experience between those employing X-ray analysis (diffraction methods) in their work in different fields and to arrange for further collaboration between physicists, engineers, chemists and others towards the solution of problems by its methods, has been arranged by the Institute of Physics, and will be held at Cambridge. The conference will be opened by the President of the Institute, Prof. Sir Lawrence Bragg, F.R.S. The first session will be devoted to a discussion on the "Quantitative Treatment of Powder Photographs," to be followed by a lecture on "Future Developments in X-ray Crystallography," by Prof. J. D. Bernal, F.R.S. At the next session, a discussion on "The Fine Structure of X-ray Diffraction" will be held, and a report on the progress made in the preparation of the X-ray analysis index, submitted by Dr. A. J. C. Wilson. A third discussion will be devoted to "Line Broadening." An exhibition of photographs, films and small apparatus cognate to the subject of the conference is also being arranged.

Further details may be obtained from the Secretary of the Institute of Physics, The University, Reading, Berks, to whom application should be made before February 24.

AMERICAN STEEL FOUNDRIES

Mr. Frank G. Steinebach, Editor of "The Foundry," in his leading article in the December, 1941, issue, states that "when war was declared, steel foundries, already overloaded with high priority work, and numerous new steel castings projects, were well under way. During the past 12 months these and other projects have been completed, plants have been expanded, and a number of iron and malleable foundries have been converted to the production of steel castings through the installation of electric furnaces or converters and the necessary heat-treatment equipment. A conservative estimate would show the capacity for producing steel castings has been at least doubled during the period of the national emergency." We have long regarded steel castings production as a reliable barometer of war-potential, and prior to the "national emergency" the U.S.A. production was already much higher than the whole of the Axis output.

"Methods of Moulding and Casting a Slide Bracket."—We regret that, in our report of the above discussion in the issue for February 4, Figs. 2E and 2F were transposed and inverted during the course of making up. In the case of Figs. 3 and 4, our blockmakers evidently disliked defects in castings, and mistaking these for blots promptly made them into sound castings! In Fig. 6 a defect appeared in the area of the vertical dotted line, where it intersects the thin horizontal dotted lines. In Fig. 3 the defect is at the junction of the sprocket and web.

BAKELITE PLASTICS AND SEALING SOLUTIONS

By R. D. ROBERTS

A General Review of these Plastics with an Appendix describing the Reclaiming of Porous Castings with Bakelite Sealing Solutions

Bakelite materials themselves may be grouped as follows:—

The Resins themselves, which are mainly used in the production of the other classes of materials, and as the bonding agents for grinding wheels, and the basis of paints and varnishes for industrial and other uses.

Cements, which may be either solid or liquid. One of the chief uses of the solid cement is for attaching the caps of electric lamps, radio valves, etc.

Lacquers, which are dilute solutions of the resinoids in organic solvents; these are used for protection of metal surfaces.

Enamels, which are pigmented varnishes used as protective coatings.

Moulding Materials.—These are compounded from resins by the addition of fillers and suitable colouring matter. They are supplied to the moulder in powdered form and need no mixing or modification. Various fillers are used in the manufacture of the materials to obtain special properties from the finished mouldings. For instance, wood flour is the filler employed in the general-purpose material; fabric in different forms for shock-resisting grades; mineral fillers, such as asbestos, for heat-resistance; and mica for high electrical properties.

Normal Applications

The general-purpose material has the widest range of applications, and is used for the manufacture of electrical instruments and accessories, telephones, motor-car furnishings such as dashboards and window frames, and the like. This material has a specific gravity of 1.35. The tensile strength is approximately 3.1 tons per sq. in. and the impact strength is 0.2 ft.-lbs. At the present time the colour range is restricted to increase production, but in normal times a wide range of colours and wood finishes is available.

The fabric-filled material has greater resistance to shock or impact than the general-purpose type. The greater the shock-resistance of the material, the more difficult it is to mould, because of the type of filler employed increases the bulk factor and reduces the flow properties of the material. An impact strength of 1.5 ft.-lb. and a tensile strength of 3.1 tons per sq. in. can be obtained from this class of material, whilst the low specific gravity of 1.35 is retained.

Heat-Resistant Material

Mouldings correctly produced from this class of material can operate at temperatures up to 200 deg. C. Due to the mineral filler used in the heat-resistant materials, the specific gravity is slightly increased, being in the region of 1.8. These materials are particularly suitable for such applications as electric iron connections, handles for cooking utensils, etc.

As the uses of Bakelite mouldings are so varied, many special materials have had to be developed to withstand the conditions met in service. In addition to those already indicated there are materials produced for water-resisting mouldings, such as water-meter parts, acid and alkali resisting mouldings, such as the bobbins used in the textile industry, and electric accumulator parts. There are also odourless materials used for food container parts, closures, etc., and materials suitable for the production of matrices and printing plates, and many others.

The moulding process of all the above materials consists of the application of heat at 150 to 175 deg. C., and pressure of 1 to 2 tons per sq. in. of the projected surface area of the moulding. This is carried out by the moulding material being placed into a heated steel mould to which pressure is applied, thus compressing the material and causing it to flow into intimate contact with the mould surfaces. Upon further application of heat and pressure, the moulding material sets to a hard, dense form, and this can be ejected from the mould whilst still hot. The period during which the mould is under pressure is referred to as the "curing time," and this varies according to the size and form of the moulding being produced. For small thin articles, the curing time may be less than a minute, but for thick section mouldings ten minutes, or even more, may be required. The type of moulding material being used has also a bearing on the curing time. The time required to cure a disc ¼ in. thick is three minutes when standard material is being used.

When the quantity of mouldings to be produced is relatively small, or when the design of the moulding necessitates a mould with a number of loose parts, portable moulds are generally used. These are usually operated by simple up-stroking presses giving a pressure of from 10 to 50 tons. The material is loaded into the mould away from the press and then placed between the heated platens of the press. The heating may be carried out by steam, electricity or gas.

When large quantity production is required, the semi-automatic press of higher capacity is used, the total pressure in some cases being as high as 1,500 tons or more. The moulds are fixed in the press and, in the majority of cases, the mouldings are automatic-

* Paper read before East Midlands Branch of the British Institute of Foundrymen, Mr. Harbach presiding.

Bakelite Plastics and Sealing Solutions

ally ejected from the mould. As the moulds are permanently in the press, they can be heated direct. These large impression moulds can very often be operated at the rate of 50 cycles per hour; therefore it is possible, with a 100 impression mould, to produce 5,000 mouldings per hour from one press.

A "Die-Casting" Process

Recently a new method, called transfer moulding, has been developed. The normal method of moulding is referred to as compression moulding, as the material is compressed and plasticised in the mould cavity itself. By the transfer method the material is compressed and plasticised in a separate cavity, and it is transferred in a state of flux through an orifice into the moulding cavity, where it is cured. The pressure cavity can be incorporated in the mould itself or as a separate chamber. If a separate chamber is employed, a number of moulds can be filled from the same chamber and the curing process carried out in separate presses. The advantages of the transfer method are that delicate inserts can be moulded in position without distortion, and long small diameter holes can be formed in mouldings, which would not be possible by the compression method.

Mould Materials

The design and construction of moulds is of major importance, as Bakelite moulding materials repeat with almost photographic fidelity the finish of the mould. When mouldings having extremely high lustre are required, chromium plating of the mould surfaces is considered standard practice. Experience has shown that steel is the most satisfactory metal for the construction of moulds. The softer metals will not stand up well under the required high moulding pressures. High-grade oil-hardening steels are mainly used, as they give the minimum of distortion in hardening and under moulding pressure.

There are three main types of compression moulds, the positive, semi-positive and flash types. In the positive type, little or no allowance is made for any excess material to escape, and therefore the full pressure is exerted positively on the moulding. With this type of mould it is necessary to load the mould with the exact amount of material. Semi-positive moulds differ from the positive type as clearance is arranged in the powder cavity to allow any excess of material to escape. This is usually arranged by the sides of the powder cavity having an included taper of approximately 3 deg., so that when the top force or plunger enters the cavity excess material can escape. When the mould is finally closed, positive pressure is applied, as there is then no clearance between the plunger and cavity. In the flash type mould, there is no cavity for the material, so tablets or pellets are usually employed which are loaded into the moulding cavity itself. It is necessary to allow a slight excess of material when using this type of mould, as the moulding powder is not enclosed until the two parts of the mould meet, and an extrusion of flash occurs. The amount of material lost is comparatively small, and is compensated by the simplicity in operation of the mould, and also the cheaper cost of construction.

The desirability for consultation and co-operation between the designer of the piece to be moulded, the moulder, and the material supplier, are obvious. By this, increased production and reduced cost can very often be obtained without losing the essential features and properties required.

When mouldings are ejected from the mould they are more or less finished products, it merely remains for the fin or flash to be removed. This is done by various methods, such as tumbling for small mouldings, and finishing bands, abrasive discs or files for larger mouldings. Mouldings may be drilled, tapped or otherwise machined but, in general, plain holes or threaded holes are incorporated during the moulding process, so machining is usually eliminated.

Evaluation of Plastics

Since the introduction of Bakelite material, people have been thinking of it in terms of a substitute. It should rather be regarded as a new material with a personality of its own, not merely as a substitute for older materials—metal, wood, or stone—but as a material having its own special properties. These properties have to be valued not only in relation to itself, but also in relation to the properties of materials which it may replace. It is not suggested that it has or will supplant metal for heavier duties in either building or machinery. It should not hastily be ranked as either inferior or superior to metal, wood or stone.

In contrast to each of these materials, it possesses inherent advantages and also limitations. It has attained its widespread adoption because it possesses a remarkable combination of properties and general adaptability. For an organic material it possesses toughness and strength which is quite unusual, and owing to the fact that it is "hardened by heat" there is little likelihood of trouble, such as the tendency to flow at normal temperature, even under pressure, as is found in the case of the older plastics. One of its great advantages is its low specific gravity, about one-sixth that of steel and one-half that of Duralumin. Its resistance to corrosion also is often the deciding factor when it replaces metals.

During the war Bakelite has replaced metal for numerous applications, and a very large tonnage of scarce metals and other materials must have been saved through this changeover. Although the strength of Bakelite materials may not be so high as some metals, its low weight allows the section of the part to be increased to give the required strength, without increasing the weight of the finished article, this, of course, when dimensional considerations permit.

Some of the mouldings exhibited may be of particular interest to foundrymen, as they have replaced castings, especially diecastings. Some combine both mouldings and diecastings.

[A film showing details of the manufacture of Bakelite moulding was then exhibited.]

Bakelite Plastics and Sealing Solutions

APPENDIX

RECLAIMING POROUS CASTINGS

By W. Bowman.

For overcoming porosity in metal castings, sealing solutions Bakelite V.1845 and N.2106 can be used. The former is a clear solution of a special resin, and is used in cases of fine porosity, whereas the latter is a solution containing a finely divided mineral filler and is employed when the porosity is of a grosser nature. These solutions may be used for both ferrous and non-ferrous metals, and factory trials have demonstrated conclusively that the results produced are highly satisfactory.

There are two main methods, one, for small castings, by which the sealing solution is forced into the casting by external pressure, and the other, for large hollow castings, by which the solution inside the casting is subjected to pressure, thereby forcing the solution through the walls from the interior. The small castings can be treated by the well-known vacuum-pressure process, in which the castings are placed in a strong container from which the air can be evacuated. When a suitable vacuum has been attained, the sealing solution is allowed to run in from the storage vessel until the castings are covered, after which pressure is exerted for a convenient time. The solution is thus squeezed into the body walls of the casting, filling the pores. After removal from the vacuum-pressure chamber, the castings are submitted to a baking operation.

In the case of larger hollow castings, an example may be taken of one having several outlets. All but one of these apertures are closed, the open one being used as a port for filling the casting with the sealing solution and as an opening through which pressure may be exerted. The casting may be either in the trimmed or untrimmed condition, since final machining can be carried out after sealing, if desired. When the remaining exits of the casting are effectively plugged and the hollow casting is filled with the sealing solution, air pressure is applied at the open port, so that the solution is forced from the interior into the pores of the metal. Any available pressure from 50 up to 250 lbs. per sq. in. may be used. If any porosity exists, the solution is forced through so that sweating occurs on the outside surface of the casting; although in the case of gross defects the solution emerges as a spray. While it is probable that a casting showing such leaks would be returned to the foundry, it may be stated that even severe porosity can be cured by two impregnations of the solution N.2106, followed by intermediate stoving.

By this impregnation process, which is carried out at normal atmospheric temperature, some of the sealing solution remains within the walls of the casting; the next step is to "fix" it therein. The solution consists chiefly of a Bakelite synthetic resin which, by the application of heat, is converted from a soluble and fusible substance into a solid which is no longer soluble or fusible, and which is highly resistant to nearly all forms of attack. This transformation is known as polymerisation, and Bakelite in this cured condition has no known solvent. The first stage of the baking process removes the solvent, and further heating leaves the pores of the casting filled with a chemically inert solid which cannot be removed by any pressures applicable to the casting in service or on test.

Polymerisation Procedure

In order to effect this polymerisation, the following procedure is adopted, although much latitude is permissible:—

(1) After the pressure has been exerted for some time as is considered necessary, the casting is drained and lightly wiped with a cloth moistened with a thinning solution in order to remove the excess of material adhering to the surfaces of the casting. This is advisable because, after stoving, the hardened Bakelite adheres strongly and would be difficult to remove except by machining or hand-tool work.

(2) The casting is now placed in a suitable oven, well ventilated, at ordinary atmospheric temperature. Heat is applied so that during the first hour the casting is brought to a temperature of about 85 deg. C.

(3) After the solvents are removed, the temperature is raised to about 110 deg. C. for an hour and finally raised to 135 deg. C. for a similar period.

When the stoving cycle is complete, the casting is sometimes refilled with sealing solution and again subjected to pressure. This second impregnation will test whether all the pores are filled; if any sweating can be observed, the casting is ready for a second stoving, which, however, is seldom required.

It will be noted that the castings have not been subjected to the usual hydraulic test; nor is this necessary, since the sealing solution itself acts as a pressure test medium which will detect any porosity and at the same time will charge the metal with the filling fluid, thus effecting a great saving of time. In fact, water must not be used; or if it were used as a test liquid, the casting must be dried thoroughly before the solution is placed therein. Of course, after the process of impregnation and stoving has been completed, the usual hydraulic tests may be carried out.

VOTE OF THANKS

Mr. P. A. Russell, B.Sc., proposing a vote of thanks on behalf of the Institute of British Foundrymen, stated his agreement with Mr. Roberts' assertion that plastics and ferrous or non-ferrous materials should not be regarded as competitive rivals. Both products were necessary to modern civilisation, and he was sure there was a market for them. He envied Bakelite in that it was a modern product with but a brief history, it had grown up under scientific control with no traditional rule-of-thumb precepts to hinder it.

Mr. Harrison, seconding the vote of thanks on behalf of Newark Engineering Society, said he had seen the productive processes in operation, particularly in connection with radio and electrical fittings, and he was sure that anyone who had experienced

Bakelite Plastics and Sealing Solutions

trouble with the early motor car and its imperfect ignition system, would be grateful for Bakelite, which combined very high resistivity with non-hygroscopic properties.

DISCUSSION

MR. PEARCE said he was impressed by the efficiency of the processes and the simplicity with which quite intricate mouldings appear to be made. Bakelite to him was an unexplored material, and he would like to know more of the mechanical properties with particular reference to wear resistance. Resinoid gear wheels had been mentioned; was there any information as to the loads which could be transmitted, and were these gear wheels used plain in bearings or do they require bushing? Many of the exhibits had an immaculate finish, as they came from moulds, and he asked if the buffing of the material produced a less perfect surface.

With reference to sealing solutions for the prevention of leakage of castings under hydraulic test, he appreciated the possibilities, but as air pressure tests were in common use to-day, how did the Bakelite seal react to such testing? It was generally considered that air pressure testing was more searching than hydraulic testing, and under certain circumstances a casting which would pass, say, 2,000 lbs. hydraulic test, might fail under air pressure test at perhaps no more than 200 lbs.

MR. ROBERTS replied that the wear resistance of Bakelite laminated material was very high, given correct design and application. Bakelite gear wheels had been known to outlast their steel counterparts. If a Bakelite gear is adequately designed for strength, the wear will look after itself. Permissible loading depended on the function they were designed to perform, and Mr. Roberts instanced their use in taking the direct drive from 100 h.p. motors. The formula for determining the h.p. is that used by the American Gear Manufacturers' Association, and technical data were easily available. Metal bushes are not essential, but can be used to advantage, in particular with taper fits, or where the key in the shaft is small.

With regard to the buffing of mouldings, this was inadvisable as this operation removed the surface film of resin which the mouldings possessed when removed from the mould. Where buffing was necessary, as in the case of telephone receivers with a long flash mark on the joint line, a special moulding material was employed which counteracted the results of buffing.

MR. BOWMAN said castings were impregnated with Bakelite sealing solution under both hydraulic and pneumatic pressure. The extent to which pneumatic pressure impregnation may be applied depends entirely on the safety limits of the castings. For example, a light aluminium hollow casting may be so filled, using air pressure on the surface at 40 to 50 lbs. per sq. in. The casting is then drained and washed free from sealing solution and then stoved. The air pressure test of one particular casting so treated withstood 400 lbs. per sq. in. air pressure.

Conditions during Curing

DR. WALTER (Lincoln Section) said he would welcome further details as to the curing stage when heat was applied to polymerise the plastic material. It seemed to him that very close control of temperature would be essential. He had noticed that the raw products were rolled between heated rolls to give plates of resinoid which were then ground up and despatched as Bakelite moulding materials. If polymerisation had already taken place, how could the resultant powder be employed as a moulding material? With Bakelite bearings what loads could be borne? The particular reference he had in mind was that of Bakelite, or non-conducting, arm in an electric coil which had to undergo a rapid intensification of load coincident with the production of an electric spark.

MR. ROBERTS replied that thorough control of both the raw materials, phenol, formaldehyde and the various fillers—and the manufacturing processes—was essential. Curing was effected in two heating stages. The first stage—as carried out during the manufacturing process—was a relatively low temperature process operating under closely defined limits. The second stage, however—that employed by the moulders using the Bakelite moulding material—allowed a wider range of temperature, *e.g.*, a satisfactory cure would take place in this stage at 280 to 380 deg. F., a range of 100 deg. F. With oil or water lubrication Bakelite bearings could be loaded up to 1,400 lbs./sq. in., at a rubbing speed of 500 to 1,000 ft. per min. When it is impossible to lubricate the material and when the rubbing speeds are sufficiently low to eliminate any temperature rise, the material would stand loads of the order of several thousand lbs. per sq. in.

MR. P. A. RUSSELL said that in every instance of the manufacture of Bakelite mouldings, polymerisation of the powder, sheet or laminations was effected by the application of two factors, heat and pressure. However, when using the Bakelite sealing solution on porous castings, heat alone was used to polymerise the plastic. He would like to know if the omission of pressure caused any variation in properties of the final product.

MR. BOWMAN replied that the conditions under which sealing solutions are applied to hollow or porous castings were precisely the same as those used for laminated sheet or powder; namely, that once pressure and heat are applied to the mouldings there was the same state of inertness as material contained in hollow castings. With regard to the latter, pressure is unnecessary once the pores have been sealed.

Distribution of Powder

MR. GLADWELL (London Branch) said he had noticed that illustrations of moulding technique, employing powdered materials, showed that no attempt was made to distribute the powder over the surface of the mould before continuing with the pressing operation. When using metal powders levelling was important to ensure a homogeneous product, so he concluded that the

Bakelite Plastics and Sealing Solutions

Bakelite moulding powder flowed very freely under the action of heat and pressure.

MR. ROBERTS confirmed these remarks by stating that the powder actually fluxes in the heated mould and under pressure the material flows readily to all parts of the mould. When mouldings having uneven sections were being produced more care in loading was desirable and practised accordingly.

MR. HALLAMORE (Lincoln) queried the apparently hygienic value of the atmosphere, however, in view of possible noxious fumes from the curing process and the extensive use of powdered materials. The sealing of porosity in metal castings seemed quite simple, but what equipment would be necessary in order to make this a routine practice, what would be the working costs of such a procedure, and what limits of section could be adequately impregnated? Finally, what percentage of scrap could be reasonably expected in a Bakelite moulding shop?

MR. ROBERTS said the conditions in the Bakelite moulding shops depended on the type and condition of the plant in use. A modern factory would be thoroughly clean and hygienic but there was room for improvement in some of the older plants. The fumes given off during the moulding operation were negligible and in no way harmful. The percentage of scrap varied according to the type and size of the mouldings being produced, an average figure would be about 5 per cent. This scrap could not be re-used as once polymerisation had taken place there was no known solvent for the resinoid.

MR. BOWMAN said Bakelite sealing solutions were mainly employed at present by users of castings as distinct from manufacturers of castings. Both solid and hollow forms could be treated using either direct or vacuum pressure to impregnate. The waste of solution was very little, as all excess sealing solution was returned to the storage vessel before baking the casting. Actual outlay would be small, but certainly some type of equipment would be necessary if mass-impregnation was contemplated; impregnation time and mass of metal were the two major cost factors.

Scrap in Moulding Bakelite

MR. KNOTT (Lincoln) asked for the causes of the 5 per cent. scrap when moulding Bakelite.

MR. ROBERTS replied that most of the scrap was caused by flash. It was necessary to use a slight excess of moulding material in the majority of moulds, but the amount varied with the type of mould employed and the size and type of moulding produced. This excess was cut to a minimum when pellets were used.

MR. STUFFINS (Newark) asked if the laminated forms of Bakelite, so widely used for machine parts, could be moulded. What were the limits of accuracy to which, say, the bore of a laminated gear wheel could conform, if it were intended for use as cast. Could it be considered common practice to cast gear wheels to finished size?

MR. ROBERTS replied it was now possible to mould laminated Bakelite to quite intricate shapes, but the impregnated fabric or paper did not flow so readily as moulding material and, therefore, more care had to be taken in placing the material in position in the mould. Only the smaller sizes of gear wheels were moulded to shape, and he would say that 1/2,000 in. was a reasonable limit of accuracy in such cases. The larger gear wheels were machine finished.

Inadequate Curing Time

MR. J. R. HORTON (Lincoln) queried the effect on properties of the finished material if the curing stage was insufficient or taken to excess.

MR. ROBERTS stated that the curing time was important. Inadequate curing resulted in blisters and lower physical properties. Excessive curing, within reason, did not affect the finished moulding.

MR. HOLLAND asked if the phenol and formaldehyde were used as bonding agent to the wood flour. In this connection, is there any reason why the scrap Bakelite could not be crushed and used in place of part of the wood flour?

MR. ROBERTS replied that the bonding agent is the resin produced from phenol and formaldehyde. Once the moulding material has been polymerised, it cannot be resoftened, and therefore the scrap cannot be re-used. Experiments have been made using ground flash as an additional filler, but the hardness of the powder damages the mould and also produces mouldings with very inferior properties.

Mending Broken Parts

MR. HARRISON (Newark) asked if a cement was known capable of mending broken Bakelite components. Also, where pellets were used as a moulding material, was there a definite formula for calculating the weight of pellet necessary to fill any given mould?

MR. ROBERTS said cements for Bakelite did exist, but their use for repairing mouldings was limited, as the cost of the repair was very often higher than that of a new moulding. It was comparatively simple to calculate the weight of moulding material to produce a given moulding, but, in works practice, trials were made to reduce the waste to a minimum.

MR. KNIGHT (Newark) asked for the voltage employed to test the electrical resistivity of Bakelite laminated sheet insulation. Also, although he realised that Bakelite would be considered an impervious material normally, how did it fare under the more exhaustive porosity tests using electricity as the testing medium, as, for instance, in porosity tests on glass?

MR. ROBERTS said the voltage employed was 500. With reference to the porosity tests mentioned by Mr. Knight, he was not aware that these had ever been applied to Bakelite. The breakdown voltage on Bakelite mouldings was between 100 to 400 volts/mil. at 90 deg. C., dependent on the grade of material.

MR. ROBERTS, thanking the members for their contribution to a most interesting discussion, suggested that co-operation between plastics manufacturers and foundrymen would result in mutual benefits. One

particular point he had in mind concerned the production of the moulds used for the production of Bakelite mouldings. These were normally constructed from high grade steels and, when only very small quantities of mouldings were required, their cost was prohibitive. Experiments had been made with cast moulds, using various alloys, but the difficulty was that they would not withstand the pressures employed in Bakelite moulding. He hoped that a solution to this difficulty would be found in the future.

MR. STUFFINS (Newark) remarked that chromium plate gave one of the hardest and least impressionable surfaces known at the present time. Was it possible to chromium plate Bakelite?

MR. ROBERTS said it was possible to chromium plate Bakelite, but so far it had not been done to any great extent.

MR. HARBACH (President), closing the meeting, mentioned that he had personal knowledge of the use of sealing solutions in a heavy steel casting which had proved to be porous under hydraulic test. The method of application had been simple and the results excellent.

WRITTEN DISCUSSION

MR. A. E. PEACE wrote that unfortunately time was short at the meeting, and his contribution to the discussion was necessarily curtailed. In amplification of his remarks upon strength properties, he asked the authors to enlarge upon the matter, particularly in the direction of strength when loaded as a beam, compressive strength and resistance to indentation. In this latter connection, whilst he was not seeking for information on hardness as usually defined, he felt that the information would probably be obtained by means of some type of indentation tests, such as were used for testing the hardness of materials. The lecturer gave the impression that the cured Bakelite was remarkably stable, and he would be interested to learn what was the maximum temperature at which it significantly lost its useful properties.

Among the exhibits there was a metal coated sheet of Bakelite, and he would like to know by what process the metal was applied. An example of patterns mounted on a plate of laminated Bakelite was shown, and he asked if there were any limitations in the method of working such pattern plates, *e.g.*, would they withstand vibrations and jolting, and would they survive rapping with a mallet such as was used in some methods of moulding?

It occurred to him that there was a useful application of moulded plastics within the foundry and engineering industry which might not be familiar to all. This was the use of Bakelite for mounting specimens for various purposes. It was used largely for metal specimens for microscopical examination, and was also most valuable in mounting very small pieces for hardness testing. In this latter connection very fine gauge wire could be mounted vertically for hardness measurement on the cross section.

Author's Reply

MR. ROBERTS, replying to Mr. Peace's first question asking for amplification of the remarks made at the lecture in connection with the mechanical properties of Bakelite moulding materials, gave the following details:—

	General purpose materials.	Medium shock-resisting materials.	High shock-resisting materials.
Impact strength (ft.-lb.)	0.17—0.22	0.30—0.37	1.00—1.50
Cross breaking strength (lb. per sq. in.) ..	10,000—11,000	10,000—11,000	12,000—14,000
Tensile strength (lb. per sq. in.)	6,500—7,500	7,000—8,000	6,000—7,000
Ultimate crushing stress (lb. per sq. in.) ..	35,000—40,000	37,000—42,000	30,000—35,000
Brinell hardness (125 kgms. on 5-mm. ball)	43—47	43—47	35—40

The maximum temperature which Bakelite moulding materials would withstand depended on the type of material used, but, as an indication, general-purpose materials would stand up to 150 deg. C. satisfactorily, whilst special heat-resisting material would withstand temperatures up to 200 deg. C. The metal face to the laminated sheet was obtained during the production of the sheet, and was not a coating applied afterwards.

He understood that Bakelite laminated material when used for pattern plates would withstand the conditions detailed by Mr. Peace. They had replaced metal pattern plates very satisfactorily and, of course, had the advantage of being very much lighter which helped in the production of castings.

Equal Density

MR. MARSHALL (Derby) wrote that during the Paper the lecturer stated that with closed moulds the exact amount of filling material must be used. Was there any latitude in this direction as laboratory accuracies could not be maintained in the shops and, if so, what was the resultant effect on mouldings produced? With "flash" type moulds, did excess material added always take the form of "flash" or did the parts vary in density? If so, how did this affect the physical properties? Finally, with regard to obtaining such finishes as the wood finish referred to, was this a highly specialised process, or could further information be given; if so, was the use of impregnated fabric necessary?

MR. ROBERTS wrote in reply that with positive type moulds it was necessary to load the exact amount of material into the mould, otherwise the thickness of the moulding varies. With "flash" type moulds, the excess material always flowed out of the mould and, therefore, took the form of "flash." The variation in the density of mouldings produced from this type of mould was extremely low and did not affect the physical properties to any appreciable extent. The

(*Continued on page* 140.)

ANNEALING PANS

By Jas. Timbrell

Mechanical appliances can sometimes be developed and put into a foundry operation to show a considerable saving in handling effort and time. Mechanised or semi-mechanised routines are usually planned to attain increased production with less effort, the "bottle-neck" (where one exists) can, under certain circumstances, be removed by a re-design or the application of special equipment. The introduction of female labour on work hitherto considered a strong man's job, has necessitated revamping on the handling side of foundry methods, to simplify and eliminate the risk and effort on semi-dangerous lifts which require slinging, etc.

FIG.1.

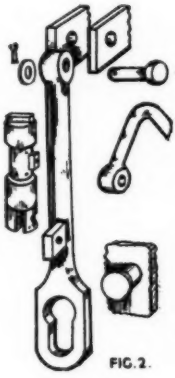


FIG.2.

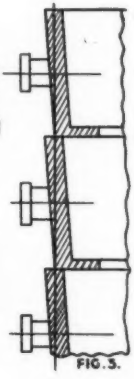


FIG.3.

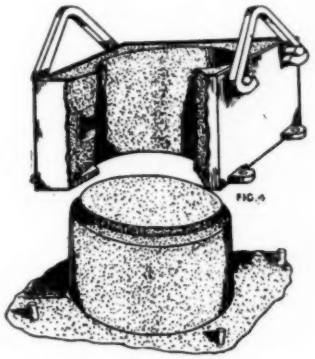


FIG.4.

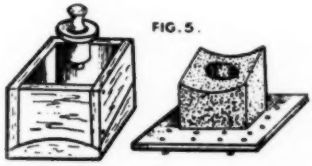


FIG.5.

Fig. 1 shows a "rig-up" for the safe and easy handling of annealing pans from a tunnel bogie. The drawings which follow Fig. 1 are largely self-explanatory—the concept illustrated is in use in some foundries as part of a "knocking-out" unit. Other applications for similar vibrator beam lifts may suggest themselves. The lifting beam and roll-over bars are shown in detail in Fig. 2, and can be varied to suit individual requirements.

If the length of crane travel is too long for the use of permanent connections to a flexible air pressure line, a snap-on coupling may be used; this will allow the air-line to be broken at a convenient point, without any loss of air pressure and also may be used as the valve for the vibrators.

The usual straight-sided annealing pans may be adapted to this trunnion lifting, and these are added by placing trunnion cores in place during the ramming-up of the open-cast mould. By setting marks for the position the core can be put on to the existing pan pattern. The trunnion corebox and a core are shown in Fig. 5. As this trunnion core is open straight through, a flat core (used as a lid) is necessary to cover the flat open side—the radius face, of course, going to the pattern face when ramming-up the mould.

The taper pan shown is a slower moulding proposition, but is compensated for by the ease of discharge of the annealed contents, and Fig. 4 shows a method of moulding this particular type. The degree of taper conforms with the "piling" as shown in Fig. 3. The cutaway section of the lifted mould and box part shows the bottom plate or inner flange of design to act as a "stripper," by means of which clean lifts are assured. Power lift is, of course, necessary for pans made this way, but usually this is also required for drawing a straight-sided pan pattern. The four stakes ensure the box going back into position after the pattern has been drawn.

Chrome Plating on Patterns.—For some very heavily mass-produced iron castings, demanding iron patterns for their production, the authorities are keen on chrome plating in order to ensure a smooth surface and prevent wear. The former can be achieved by allowing the patterns to rust and then cleaning off carefully all deposit and polishing.

BAKELITE PLASTICS AND SEALING SOLUTIONS

(*Continued from page* 138.)

wood finishes on laminated materials were obtained by using a printed paper for the top layer. It was not possible to obtain a wood finish with fabric materials.

Metal Filled Bakelite

MR. S. A. HORTON wrote that the illustrations showed there was apparently a considerable outlay of capital in the manufacture of the moulding equipment prior to the production of the Bakelite moulding, and he would, therefore, be interested to know what minimum quantity it was considered an economical proposition to produce taking as examples: (1) Electric light switches; (2) automatic dashboards; and (3) wireless cabinets. Was it possible to introduce powdered metal to the wood flour filling with the idea of producing a bearing bush?

MR. ROBERTS in reply wrote that the minimum quantity of mouldings required to make the construction of moulds an economical proposition, depended entirely on the size and form of the moulding. For instance, a small simple design could be produced from a mould costing, say, £20, whereas a large intricate moulding might require the expenditure of anything up to £1,000. He considered the minimum quantity of electric light switches to be produced as an economical proposition would be say, 500 gross, automatic dashboards 5,000, and wireless cabinets 5,000. It was possible to use powdered metal as a filler for moulding materials, but, so far, there had not been a big demand for this type of material.

FUEL CONVERSION FACTORS

In view of the number of requests from various industries, and the importance of making an assessment of the relative efficiencies of different fuels in use in each industry, the Ministry of Fuel and Power has proposed that a comparison between fuels (coal, oil, gas and electricity) should be made on the basis of calorific value, assuming a complete conversion to heat in each case. The following figures have been suggested for this purpose, but it should be understood that they are only intended for approximate calculations; and they have, therefore, been rounded off for the sake of convenience:—1 ton of coal, 280 therms; 1 ton of coke, 280 therms; 1,000 cub. ft. of gas, 5 therms; 1 ton of oil, 400 therms; 1,000 k.w.h., 34 therms.

The above figures assume the following calorific values:—Coal and coke, 12,500 B.Th.U. per lb.; gas, 500 B.Th.U. per cub. ft.; and oil, 18,000 B.Th.U. per lb. When the actual calorific value of the fuel is known, adjustment to therms can be made accordingly. If these figures are used with reasonable discretion, they should serve as a useful guide in assessing the fuel and power consumption per unit of product.

HEALTH HAZARDS IN THE MAGNESIUM INDUSTRY

Dr. Harold H. Gay, the author of an article on this subject, printed in the December 3 issue of "The Iron Age," is the medical director on the staff of the Dow Chemical Company, and his views must be taken seriously. From a study of his article we have received the following impression, but for those whose activities require that they be better informed, recourse should be had to the original article. Of the metal itself, it seems that this can be absorbed by the human system, but there is perhaps a beneficial rather than a toxic effect. Unlike brass, zinc and some other metallic substances, its fume does not produce "fume fever." Some German research workers have tried to prove that magnesium has toxic properties, but this is quite unsubstantiated, and is due, in the doctor's opinion, to the bacteriological contamination of the too-repeatedly used cutting oils, consequent upon shortages. The prevalence of sulphur dioxide in magnesium foundries seems to be quite harmless except for such persons who are naturally prone to being adversely affected by this gas. The major complaints invariably arise from the maintenance men and the like, who make irregular visits to the foundry and seldom from the permanent staff. The idea that dermatitis can be caused through handling magnesium has no solid foundation, and the author has been able to ascribe every suspected case to some other source. The hazard from magnesium dust is a real one, and from this as well as from other angles it should be eliminated by the exercise of proper precautions.

NOTES FROM THE BRANCHES

London Branch.—The next meeting will be held on February 20 at 2.30 p.m. at the National Liberal Club, Whitehall Place, London, S.W.1, when Mr. A. Burgess, of Stuart Turner, Limited, Henley, will read a Paper on "Processes in the Manufacture of Small Castings," which will be illustrated by lantern slides.

FOUNDRY COSTING

In view of the continued demand for "Recommendations concerning the Establishment of Costs in a Grey Iron Foundry" by the Costing Sub-Committee of the Technical Committee of the Institute of British Foundrymen, the Institute has reprinted the Report in cyclostyle form. The Report was first published at the Annual Conference of the Institute in 1937, since when it has been widely discussed and its recommendations adopted by many foundries throughout the country. The present reprint contains a number of minor revisions made by the Costing Sub-Committee, and is obtainable from the Institute at St. John Street Chambers, Deansgate, Manchester, 3, price 2s. 6d. to non-members and gratis to members.

COAL DUST AND FUEL OIL IN MOULDING SAND*

General Review of Properties and Uses of Additions to Foundry Sand

By ELMER C. ZIRZOW†, Cleveland, Ohio

As far as is known seacoal originally derived its name from the fact that it was a coal which was shipped by sea or taken from mines which were located beneath the sea in Wales. At the present time, when seacoal is referred to in American literature any ground coal dust is meant. This dust is ground in various types of mills and pulverisers to varying degrees of fineness. Some foundries find it profitable to grind their own product but the majority of users prefer to purchase it in the ground state. Coal dust is placed in moulding sand for two reasons: (1) To prevent the sand grains from burning on to the metal, and (2) to improve the finish of the casting.

Theories on Coal Dust Reaction

Several theories have been advanced as to the action of coal dust in preventing the sand from burning on to the casting but perhaps the most logical explanation, and the one that has the most merit, is that of a reducing agent. By the introduction of any carbonaceous material, the atmosphere on the inside of the mould is held free from oxygen. This oxidising material must be present to form the iron silicates that are found on the surface of burned-in castings. This theory is further substantiated by the fact that the amount of coal dust must be increased directly in proportion to the temperature at which the castings are removed from the sand.

In other words, if a casting be removed from the sand, after it has cooled completely, the amount of coal dust required for the mould will be less than in a mould from which the casting is shaken after it has just barely solidified. The latter condition is true of most castings made on continuous conveyors where the time cycle of the conveyor is not long enough to permit the casting to cool to a dull red or black heat. When castings are dumped from conveyors in this condition, the oxygen of the atmosphere has an opportunity to react with the sand grains and iron to form the iron silicates. This must be prevented by having sufficient carbonaceous material present so that the oxygen will react with this material rather than with the iron and sand.

The fact that it is impossible to ram moulds to such a degree of hardness that the openings between the sand grains would be microscopic in size, is the reason why coal dust must be used to improve the finish. This is accomplished not only by the coking action of the coal, but also by the gas content which causes a cushion to be formed at the surface of the casting. This gas cushion, along with the coke, fills all the voids between the sand grains, giving the desired smooth surface.

Effect of Heat Application

A mould can be compared to a retort for the distillation of coal to form coke. The heat is applied by the molten metal entering the mould cavity. The first reaction that takes place in a green-sand mould is a drying action. All the tempering moisture must be first driven from the mould at the casting surface. The temperature then rises until the combined moistures of the clay and coal dust are driven off. Finally, the distillation of the coal commences.

As the distillation of the coal proceeds, the coal dust becomes a fluid tarry mass, filling up the voids created by the contraction of the clay and the expansion of the silica grains. These reactions occur almost simultaneously and can be noted by observing the pouring of any green-sand mould to which coal dust has been added.

First the steam is noted issuing from the mould, then the blue flame caused from the ignition of the water-gas, which is formed just as the distillation of the coal starts, and finally the smoke or distillation products. If the sand is examined carefully after the mould has been shaken out, minute particles of coke can be found.

Selection of Coal Dust

Several factors must be taken into consideration in the selection of the proper coal dust:—(1) Weight of the casting; (2) surface area of casting; (3) cross-sectional area of casting; and (4) grain fineness of sand.

Weight of Casting.—The weight of the casting enters into the selection of the proper coal dust only because of its effect on ferro-static pressure. The fixed carbon for heavy castings should be greater than for light castings; in other words, more coke and less volatile combustible matter (V.C.M.). The opposite is usually true of a light casting.

Surface and Cross-Sectional Area.—The surface area and the cross-sectional area of the casting must be taken into consideration, because of the possibility of misruns or cold shuts. In a light, thin-walled casting with an excessive amount of V.C.M. present, the gas formed will chill the iron. On castings with a large surface area, the binding action of coke or fixed carbon is necessary to prevent buckles in the sand. On the other hand, the chilling action of the V.C.M. will prevent the temperature of the sand from becoming excessive.

In other words, the coal-dust function is one of compensation on one hand for the contraction of the

* A Paper read before the Cleveland Meeting of the American Foundrymen's Association.

† Core Room Foreman, National Malleable and Steel Castings Co.

Coal Dust and Oil in Moulding Sand

clay, and on the other hand the expansion of the silica grain. This does not mean that coal dust will be a cure-all for defects of this type.

Sand Fineness.—The grain fineness of the sand will help to determine the amounts of coal dust and its desirable fixed carbon. The coarser-grained sands usually require a coal dust with a high fixed carbon and a low V.C.M. The opposite is usually true of finer-grained sands. It also is usually considered advisable to use a fine ground coal dust with a fine-grained sand and coarse coal dust with a coarse-grained sand.

Analysis of Coal Dust

Coal dust should be analysed for the following:—(1) Volatile combustible matter; (2) fixed carbon; (3) total carbon; (4) sulphur content; (5) ash content, (5*a*) ash fusion per cent.; and (6) fineness. It is necessary to analyse for V.C.M. to determine the amount of gas which will be produced. The fixed carbon likewise will determine the probable amount of coke that will be produced by a unit volume of coal. The total carbon is used, in some cases, in determining the coal-dust content of the sand. This determination is not absolutely necessary. An excessive amount of sulphur is not desirable in a coal dust.

The ash content should be as low as possible to lessen the contamination of the sand heap from that source. Ash fusion point should be kept as high as possible, because, if it is too low, the ash will fuse with the sand and metal. Fineness is important not only from the standpoint of proper distribution in the sand, but also for its effect upon the coking action of the coal. As explained previously, the desired fineness of the coal dust is usually dependent upon the fineness of the sand.

Methods of Adding Coal Dust

Coal dust can be added to foundry sands in any one of four ways: (1) Raw; (2) with rebonding mixture; (3) with facing sands, and (4) with burned sand at mill. The simplest way is to add the coal dust raw or distribute it evenly on the heap and cut it in with an ordinary sand cutter.

For continuous systems, which do not have any mills in conjunction with them, the coal dust is added directly to the sand tempering belt. This method is not the most desirable because of the impossibility of getting a thorough mix. There is also the chance of coal dust mixing with the clay and forming balls of coal dust and clay. The danger of segregation is always greater when coal dust is added in this manner. However, with the proper amount of control, it can be added in this way, and very satisfactory results can be obtained.

In some cases coal dust is added with the rebonding mixture, but here again there is always the danger of segregation. A rebonding mixture must, of necessity, be rich in clay and, even under the most careful milling conditions and unless the rebonding mixture is held on the dry side, the coal dust and clay will have a tendency to ball-up.

Wherever possible, it is advantageous to run a facing sand rich in coal dust. In the preparation of the facing sand, mixing conditions are usually ideal. However, in continuous systems, the amount of facing sand used is so small that it is impossible to get enough coal dust into the systems by this method.

Usually on continuous systems there is a quantity of burned sand or core sand coming off the casting cooling conveyors. This sand can be returned to the mill and mixed with a high percentage of coal dust. This method is by far the most satisfactory but, in many cases, it is not practical, either because of mill capacity or because there is not sufficient burned sand coming from the casting conveyor.

The systems which have the mills directly incorporated provide the best means of adding coal dust. In this case, small amounts of coal dust and clay are added continuously and a thorough mixture is assured.

Factors Determining Amount of Coal Dust Added

The amount of coal dust to be added is dependent upon:—(1) Amount of burned core sand; (2) condition of castings when dumped; (3) length of time castings are in contact with sand; (4) area of casting surface; (5) thickness of various cross-sections of castings; (6) metal pouring temperature, and (7) permeability of sand.

Amount of Burned Core Sand.—Burned core sand which becomes incorporated into the system or heap at the shake-out, increases the volume of the sand grains. Additional coal dust must be added to compensate for this material. There is, however, a slight amount of carbonaceous substance remaining on these grains from the oxidation of core oil.

Conditions of Castings When Dumped.—If a mould is dumped just after solidification of the metal, the percentage of coal dust in the sand must be greater than in a mould in which the casting is cooled to a black heat. This has been explained more fully previously. However, the distillation of the coal will proceed to a greater depth in the latter.

Casting Area and Cross-section.—The greater the surface area of the casting the greater will be the amount of coal dust that will be converted to ash. Likewise, the greater the cross-sectional area of the casting, the greater will be the heat penetration of the sand.

Pouring Temperatures.—Higher metal pouring temperatures necessitate greater additions of coal dust. A matter of 25 deg. C. difference in pouring temperature will produce a marked effect on the appearance of the castings.

Permeability.—Higher permeabilities in sands permit greater dissipation of heat through the sands, with the resultant effect upon the coal dust.

Determining Coal Dust in Foundry Sand

Various methods are used for determining the coal dust content of foundry sands. R. E. Aptekar gives a detailed and elaborate method. However, for

Coal Dust and Oil in Moulding Sand

ordinary control work, a total carbon determination is all that is necessary. This is assuming that all operating conditions are constant, and that there will not be a big difference in the volatile combustible matter in the sand.

Still another method used for controlling the amount of coal dust is to keep a record of the pounds of coal dust used per ton of metal poured. Regardless of which method is used, the percentage of coal dust used is determined largely by the appearance of the surfaces of the castings.

Effect of Coal Dust on Sand Properties

The following properties of foundry sand are affected by the addition of coal dust: (1) Green strength; (2) permeability; (3) contraction and expansion; (4) deformation and resiliency; and (5) moisture.

Green Strength.—One investigator shows that an addition of 12 per cent. coal dust to a sand that has not been contaminated by ash will double its green strength. However, when any ash is present this does not hold true to such a marked degree. The reason for this increased green strength with the addition of coal dust is not easily explained. In all probability, a better distribution of the clay around the sand grain is obtained. The coating of clay is actually thinned out around the grains thereby approaching more nearly the maximum efficiency of the adhesive property of the clay bond.

Permeability.—The slightest addition of a coal dust to a foundry sand will lower the permeabiljty. The cause for this is self-explanatory. Coal dust, being a very fine material, helps to fill the voids between the sand grains. As the coal dust percentage in the sand is increased, the permeability is diminished.

Expansion and Contraction.—Coal dust decreases both the contraction and expansion of moulding sand. Dietert and Valtier* prove this quite conclusively. This was also pointed out earlier in this Paper under the description of the action of coal dust during the pouring cycle.

Deformation and Resilience.—Dietert and Valtier also show that the deformation of a moulding sand will be increased with the addition of coal dust up to 6.0 per cent. If the percentage is increased to over 6.0 per cent. the deformation will be reduced gradually as the percentage is increased. The resiliency is affected likewise, although it is decreased less rapidly after reaching the 6.0 per cent. peak. The reason for this is that, although the deformation decreases after a 6.0 per cent. addition, the green strength still increases. As a matter of fact, the resiliency curve becomes almost a straight line.

Moisture.—Coal dust, being a very fine material, has a very large surface area. This increased surface area necessitates an increase in the moisture content of the moulding sand to obtain a proper temper. Unfortunately, this increases the amount of steam produced in the pouring operation. This serves in a small degree to offset the efficiency of the coal dust.

Penalties for Improper Use of Coal Dust

Certain casting defects can be directly attributed to the improper use of coal dust: (1) Rat tails; (2) cold shuts; (3) misruns; (4) dirt; (5) drops; and (6) surface checks. All these defects are caused by the addition of too much coal dust. Cold shuts usually occur in thin-walled castings. If the moulding sand is too close and too much gas is produced, castings will misrun. These misruns usually appear on the sharp contours of the castings, especially on the cope half. Surface checks are similar to cold shuts, but will occur on any wall section. Dirt and drops are caused by the contamination of the moulding sand by the ash and by not observing the usual precautions in tempering sand. Improper mixing of the coal dust will produce rat tails. This defect is not common but can be noted occasionally.

Fuel Oil Plus Coal Dust

Fuel oil can be used in conjunction with coal dust. The practice of using fuel oil in foundry sand is comparatively new and not a great deal is known about its effect. W. G. Reichert mentioned the use of fuel oil in foundry sand in an article published about 10 years ago. The greatest objection to the use of fuel oil is the amount of smoke or fumes produced. Some foundries make a common practice of oiling metal patterns. Castings made from the moulds, after a pattern has been heavily oiled, appeared to have a much cleaner surface.

After repeated observations of this condition, the oil was incorporated directly into the sand heap. This was tried first on a small sand heap. The results were most gratifying. Not only did the castings have a better finish, but the stickiness of the sand was reduced considerably. However, it was still necessary to oil the pattern occasionally. After this trial on the single heap, fuel oil was added to one of the sand systems. The same results were noted. However, in the sand systems, it is much easier to control the physical properties of the sand. To begin with, no changes were made in the sand properties or in the percentage of coal dust. Any ordinary fuel oil may be used for this purpose. An oil with a low percentage of sulphur and a Baumé gravity between 20 and 30 deg. has given the most satisfactory results.

Methods of Adding Fuel Oil.—Fuel oil may be added to the moulding sand in the same manner as coal dust, namely: (1) With facing; (2) at tempering belt; and (3) with rebonding mixture. A definite predetermined amount may be added with each batch of facing sand. The quantity of oil added per batch is dependent upon the requirements of the facing in the foundry. Additions of oil will vary from one quart to 3 galls. per 800 lbs. batch of sand. The oil is added at the same time as the tempering moisture.

* Dietert, H. W., and Valtier, F., "The Expansion and Contraction of Molding Sand at Elevated Temperatures," Transactions, American Foundrymen's Association, Vol. 43, pp. 107-124 (1935).

Coal Dust and Oil in Moulding Sand

Typical Mixtures

The following are some typical sand mixtures which can be used:—

Mix No. 1: 40 shovels system sand and 8 quarts oil.

Mix No. 2: 35 shovels system sand; 5 shovels bank sand (grain fineness No. 100); 200 cub. in. coal dust; and 5 quarts oil.

Mix No. 3: 40 shovels sand; 2 shovels sharp sand (grain fineness No. 30); 100 cub. in. Southern bentonite; 100 cub. in. Western bentonite; 50 cub. in. cereal flour; 200 cub. in. coal dust; and 1 quart oil.

Mix No. 4: 40 shovels system sand; 100 cub. in. Western bentonite; 150 cub. in. cereal flour; 600 cub. in. coal dust; and 12 quarts oil.

Mixtures Nos. 1, 3 and 4 were used for specific types of castings. Mixture No. 2 is an all-purpose

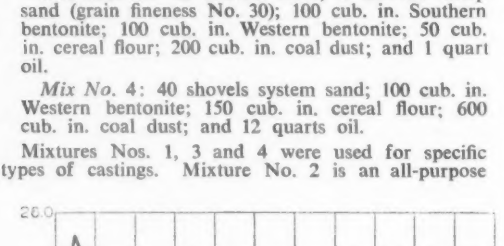


FIG. 1.—POUNDS OF COAL-DUST PER TON OF IRON PER DAY'S OPERATION FOR ONE MONTH.

facing and is the most widely used. As far as can be ascertained, the most efficient method of adding the oil to the systems is to make a constant addition at the pug mill immediately after the final addition of moisture. The oil is added continuously from a reservoir directly over the mill. The amount to be added will vary from 3 quarts to 5 galls. per hr., dependent upon the tonnage of iron poured.

Fuel oil can be added to the rebonding mixtures in the same manner in which it is added to the facing sand mixtures. The moisture contents of the rebonding mixtures can be reduced considerably if some fuel oil is used. This helps to eliminate the formation of segregations of clay and coal dust. All three methods of adding the fuel oil to the foundry sand give equally satisfactory results. The usual amount of care must be observed in mixing to obtain a uniform mixture.

Effect of Fuel Oil on Sand Properties

Certain definite improvements in the properties of moulding sand are obtained by the use of fuel oil:—(1) Increases the amount of V.C.M.; (2) aids in obtaining proper temper; (3) prevents sand from sticking to the pattern; (4) reduces rate at which sand will dry out, and (5) reduces amount of coal dust.

Fuel oil is very nearly 100 per cent. volatile matter. By the addition of fuel oil to the foundry sand, the

FIG. 2.—PINTS OF FUEL OIL USED PER TON OF IRON CAST DURING THE SAME PERIOD AS USED TO COMPILE CHART IN FIG. 1.

V.C.M. is increased directly in proportion to the amount added. A small amount of petroleum coke is produced during the pouring cycle. This increased amount of V.C.M., plus the petroleum coke, aids in equalising the expansion and contraction of the foundry moulding sand at elevated temperatures. This aids in the elimination of buckles in the mould. It is particularly effective on castings having large surface areas, such as stove plate.

Through the addition of fuel oil to the system sand, it has been possible to reduce the moisture content about 0.5 per cent. This has proved particularly advantageous because, by doing so, one can more nearly

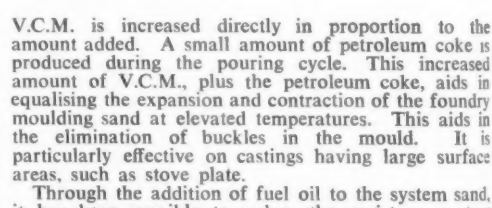


FIG. 3.—COAL DUST USED PER PINT OF FUEL OIL USED DURING THE SAME PERIOD AS USED TO COMPILE THE CHARTS IN FIGS. 1 AND 2.

approach the optimum moisture content. This has not only effected a saving in the amount of clay bond used, but has also helped increase the permeability of the foundry sand. There seems to be less of a tendency of the oiled sand to dry out in the sand hoppers. This is probably due to the emulsifying of the oil

Coal Dust and Oil in Moulding Sand

and water in the mixing operations. Battelle Memorial Institute, Columbus, Ohio, is conducting tests at the present time on this condition. The figures are not yet available.

Savings Effected

Since the practice of adding fuel oil to the foundry sand was started, the amount of coal dust added has been reduced about 30 per cent. This is quite a substantial saving in coal dust. Fig. 1 shows the pounds of coal dust used per ton of iron per day's operation. This shows during this particular month's operation a maximum of 25 lbs. and a minimum of 19 lbs. of coal dust per ton of iron.

Fig. 2 shows the pints of fuel oil used per ton of iron during the same period. The maximum amount of oil used was 3.5 pints, the minimum 2.7 pints. From these graphs it will be noted that both the pounds of coal dust and the pints of fuel oil used per ton of iron were quite constant.

Fig. 3 shows the pounds of coal dust used per pint of fuel oil. A maximum of 9.6 lbs. and a minimum of 6.7 lbs. of coal dust were used per pint of fuel oil during this period. The average for the month was 7.5 lbs. of coal dust per pint of fuel oil. Since a pint of oil weighs about 1 lb., the ratio by weight was 7.5 lbs. of coal dust to 1 lb. of fuel oil.

Conclusion

It has not been the intention of the writer to show any new and startling developments in the use of coal dust and fuel oil. The aim has been merely to give a general review of the properties and uses of coal dust and fuel oil in a fairly simple manner in order that the functions of these two ingredients in foundry moulding sand might be more clearly understood by the ordinary foundryman.

TINPLATE WORKERS' WAGES

Wage increases for workers in the Welsh tinplate industry of roughly 5s. a week for adults and 2s. 6d. a week for girls and youths are announced. They are the outcome of negotiations at the joint standing committee for the industry. It was decided that the basic figure for determining the cost-of-living bonus, which is paid at the rate of 0.8d. per shift to all male adults, should be reduced from 76 to 62 points. The bonus for female workers and juveniles is to continue at the rate of 0.4d. a shift. The decision means that adult males will, on the average, have an increase of approximately 5s. per week and females and youths under 21 about 2s. 6d. per week. It was also agreed that the 15 per cent. cold-roll bonus should include all datal workers within the juvenile agreement.

MR. JOHN FLEMING, late of Wilsons & Mathiesons, Limited, ironfounders and gas stove makers, Leeds, died on February 10.

FUTURE OF THE EXPORT TRADE

In the course of an address on "Exports After the War," given by Mr. E. P. Harries (organising secretary of the T.U.C.) before the Institute of Export, Mr. Leslie C. Gamage (general manager of the General Electric Company, Limited) presiding, the speaker pointed out that post-war trade falls into two main sections—immediate post-war and ultimate post-war. The first period would probably be one of rehabilitation lasting from two to five years, according to the countries concerned. Discussing the second period, the speaker said it would be generally agreed that the future of world export trade depended upon raising the standard of living of all countries. Backward countries must industrialise. Speaking generally, agricultural development did not increase the standard of living. Industrialisation did. Any country which developed uneconomic industries would suffer. Argentine should obviously develop a leather trade and not steel. New Zealand—wool textiles, not chemicals, etc. If the rehabilitation period was successful, some form of international co-ordination should remain—possibly an International Development Board, financed by Government grants. Industrialisation could be financed in three ways: (*a*) Government grants, (*b*) foreign loans, (*c*) cutting down imports and increasing exports. The third alternative was prejudicial, and the second had resulted in the past in the loss of considerable sums. The day was probably past when countries would pawn themselves to other countries. Foreign loans should therefore always contain repayment provisions. The lesson of the pre-war slumps was that diversification and adaptability were needed; labour industrially must be more mobile and better educated. More comprehensive social services would assist mobility.

Direct Subsidies Opposed

Continuing, the speaker said he personally was opposed to direct Government subsidies for industry (the possible exception being agriculture), because of the impossibility of maintaining efficiency. Government assistance could be given in many ways: (*a*) State credits (including Colonial development); (*b*) for capital export goods, training facilities for foreign executives in handling of steelwork, electrical plant, mining machinery, etc., in this country; (*c*) facilities and, if necessary, grants for research; (*d*) obsolescence allowance in addition to depreciation for plant; (*e*) better technical training facilities for workpeople.

When all was done, however, there remained the need for initiative on the part of the exporters. It was essential to maintain commercial centres for the use of exporters in all customer countries, and commercial representatives abroad should be of the highest class and qualifications.

Finally, the speaker said it was postulated that if the monetary policy of the allied nations returned to a tie up with gold, slumps and booms would succeed one another as in pre-war periods. The amount of available money should be tied to the productivity of the country concerned and not to any available amount of gold.

INDUSTRIAL PROSPECTS AFTER THE WAR

It was announced in the House of Commons recently that a special committee was at work planning for a resumption of export trade and that it had approached 52 industries in all.

The initial approach to these industries was made by means of a questionnaire, which it was asked should be returned to the Department of Overseas Trade on completion. Subsequent discussions between the Department and the industries concerned take place on the basis of the information supplied.

Following are some of the questions to which the Department seeks replies:—

Has the industry been diverted to any large extent to a different type of production? If so, how long after the war will it be before it can restart peace production?

Can you give a rough estimate of the number of workers the industry will be able to employ on peacetime production (*a*) immediately after the armistice, and (*b*) when it is again in full production?

Do you anticipate any special difficulty in obtaining adequate supplies of raw materials immediately after the close of hostilities?

Has any large proportion of the labour—especially skilled labour—of the industry been called up or transferred during the war?

Have the plant and machinery of the industry been subjected to excessive wear and tear during the war? Will heavy expenditure on replacements be necessary after the war and will they be obtainable in the United Kingdom?

Can it be said that, generally speaking, the plant and machinery of the industry are thoroughly modern and up to date?

Can any idea be given as to probable post-war demand for the products of the industry? Is post-war finance likely to be a difficulty?

Does the problem of the disposal of surplus stocks at the end of the war affect the industry to any extent?

Overseas Market

What are the prospects of attaining or exceeding the pre-war volume of exports (*a*) in the immediate post-war period, (*b*) later? Will any former markets be lost or new ones gained?

Would prospects be improved if some facilities could be given prior to the armistice?

Has Imperial preference or any particular trade agreement been of any great benefit to the industry and how far do you depend upon it?

Before the war was the export market as profitable per unit sold, as the home market? What was the pre-war ratio of overseas and home sales? Was export confined to a few firms, or undertaken by the majority?

What use is made of the Export Credits Guarantee Department?

Has ability to compete been affected by freight charges at rates higher than available to competitors in other countries?

IN PARLIAMENT

Music in Factories

MR. OLIVER LYTTELTON (Minister of Production) told Sir I. Fraser he was advised that the result of a recent decision in the Court was that factory managements who wished to broadcast "Music While You Work" programmes must secure the permission of the owners of the copyright in the items concerned. He understood, however, that appropriate arrangements for this purpose could be made without difficulty.

Shipbuilding Steel

In reply to a question, MR. OLIVER LYTTELTON (Minister of Production) said there had been no serious complaints of any shortage of steel for shipbuilding during the last few months. One or two isolated instances had occurred in which repair work had been held up by delays in the delivery of plates. The interference with new construction had been negligible.

Tinplate Industry Concentration

Mr. J. Griffiths was informed by the PARLIAMENTARY SECRETARY TO THE MINISTRY OF PRODUCTION (Mr. Garro Jones) that, subject to the changing demands of war production, there was no reason to anticipate that further tinplate mills would be closed down.

NEW STEEL SCRAP SPECIFICATION

The Ministry of Supply has issued the Control of Iron and Steel (No. 29) (Scrap) Order, 1943, which came into force on February 10.

The Order adds a new specification to the table of specifications set out in Table 11B of the Iron and Steel (No. 14) (Scrap) Order, 1940, of scrap for use in the manufacture of steel ingots. This new specification, which is numbered 3(b), is substantially the same as the existing specification numbered 3, save that the scrap is limited in size to 1 ft. 6 in. in any direction. The price is the same as that at present in force for specification No. 2. The existing specification No. 3 has been slightly amended in the description and re-numbered as 3(a). The price differential for quantities of 50 tons and upwards under the new specification is the same as that in force for specifications 4 to 15.

Copies of the Order, the Control of Iron and Steel (No. 29) (Scrap) Order, 1943 (S.R. & O. No. 170), price 1d., can be obtained from H.M. Stationery Office or through any bookseller.

A NEW ORDER issued by the Ministry of Supply prohibits the manufacture or assembly of hand tools, and wooden handles for these tools, except under licence. Production of hand tools by a manufacturer for use in his own works by his own workpeople is not included in the Order, which operates from March 22.

STANTON *Dale* REFINED PIG IRON

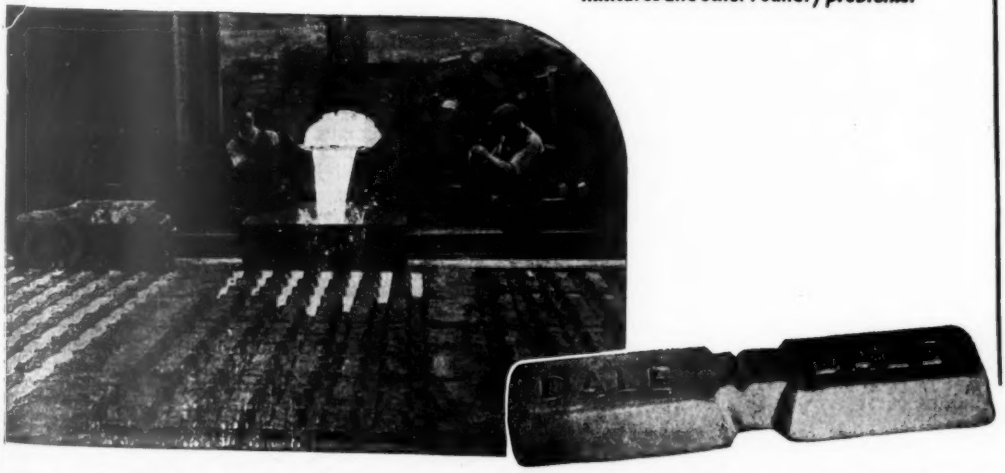
IS CHARACTERISED by closeness of grain structure, uniformity of composition and fine graphitic carbon evenly distributed.

IS PRODUCED to guaranteed analysis in seven standard grades.

CAN BE MADE to customers' individual requirements with total carbon from 2·6 per cent. upwards.

SHOULD BE USED to tone up high phosphorus irons and scrap, to replace Hematite, and to produce castings for all high duty purposes.

Users are invited to avail themselves of the Stanton Technical Service which offers free expert advice on special mixtures and other Foundry problems.



THE STANTON IRONWORKS COMPANY LIMITED, NEAR NOTTINGHAM

NEWS IN BRIEF

POPLAR ENGINEERING, LIMITED, Park Road, Chesham. is being wound up under a High Court order.

ACCORDING TO an announcement by the Meehanite Metal Corporation, Pittsburgh, Pennsylvania, the J. McMeekan Company of Southern Rhodesia is now a manufacturer of Meehanite castings. This company is the ninth manufacturing firm to go into the production of Meehanite castings in South Africa.

OF THE ISSUE at 8s. each of 300,000 5s. ordinary shares of Heenan & Froude, Limited, engineers, approximately 86 per cent. of the shares was subscribed by shareholders. The offer was in the proportion of one new share for every three held. The balance of 14 per cent. will be taken up by the underwriters.

A JOINT MEETING of the Ebbw Vale Metallurgical Society and the Iron and Steel Institute will be held on Thursday, February 25, at 7 p.m., at the Workman's Hall, Ebbw Vale. Mr. Norman R. James, chairman of the Society, will preside. Mr. James Mitchell, of Stewarts and Lloyds, Limited, will give a lecture on "Rimming Steel."

SHAREHOLDERS in Newman Industries, Limited, electrical and mechanical engineers, are being invited to subscribe for 433,333 2s. ordinary shares at 4s. each in the proportion of one for every three held. The issue is to provide funds for the redemption of 94,000 £1 6 per cent. redeemable cumulative preference shares. A new issue of 200,000 £1 6 per cent. redeemable convertible preference shares is being placed.

PRESIDING AT THE ANNUAL MEETING of the Dunswart Iron & Steel Works, Limited, held in Johannesburg, Mr. A. S. Hersov said that the plant had operated satisfactorily during the year and was well maintained. A ready market was available for both rolling mill and foundry products. Stocks of scrap were maintained at as high a level as possible under present conditions and notwithstanding considerable difficulties adequate supplies of imported stores have been kept in stock.

OBITUARY

MR. R. P. PATON, formerly works manager at the Clydebridge Steelworks of Colvilles, Limited, died at Cranstock, Cornwall, recently. Mr. Paton retired some years ago.

MR. HERBERT JOHN COWLING, well known in South Wales engineering circles, has died. Formerly a partner in the firm of Cowling & Scott, Newport, he had recently held an appointment in Wales with the Ministry of Supply.

MR. THOMAS ARTHUR CALOW, managing director of the Sheffield Forge & Rolling Mills Company, Limited, died suddenly last week, aged 57. He was appointed managing director five years ago, having previously been with the firm for many years.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s each.

550,039 DAVY & UNITED ENGINEERING COMPANY, LIMITED. Stretching and levelling of metal strip material.

550,043 WITTER, C. A. Metallic shell bodies and methods of making same.

550,051 BABCOCK & WILCOX, LIMITED, and DAVY, C. H. Method of and means for expanding tubes.

550,069 HILL, E. P., and METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED. Electric motor equipments for driving rolling mills.

550,098 WITTER, C. A. Methods of making metallic shell bodies.

550,126 INTERNATIONAL COMBUSTION, LIMITED, and JAMES, E. R. Method of producing metal shells and casings.

550,132 DAVY & UNITED ENGINEERING COMPANY, LIMITED. Apparatus for shearing strip material.

550,133 WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY. Metal carbides.

550,199 RENNY, J. L. S. Apparatus for use in the manufacture of barbed wire.

550,204 BRASSERT & COMPANY, LIMITED, H. A., and NISSIM, R. Furnaces.

550,216 BRASSERT & COMPANY, LIMITED, H. A., and NISSIM, R. Electric arc furnaces.

550,230 HILL, J. A., and CUNLIFFE-OWEN AIRCRAFT, LIMITED. Method of and means for forming recesses, depressions, or the like in thin material such as sheet metal.

550,263 ORR, JUN., J. B. Uniting metal members together by welding and the like.

550,295 FERRO ENGINEERING COMPANY. Hot-tops for ingot moulds.

550,304 AJAX ELECTRIC FURNACE CORPORATION. Electric induction furnaces.

550,321 SANDBERG, C. P., and GRAHAM, A. J. W. Method of and apparatus for the heat-treatment of steel rails.

550,351 DANIELS, LIMITED, T. H. & J., and DANIELS, J. L. Injection mechanism of die-casting machines.

FUTURE OF INDUSTRIAL WALES

Wales had built her industrial system on far too narrow a basis to provide a secure livelihood, said Mr. James Griffiths, M.P., at Llanelly last week. A supreme effort must be made to reconstruct Welsh industrial life. Two Welsh industries, coal and metal, were largely dependent upon export trade, and the prospect of recovering export trade depended largely upon the peace settlement. The tinplate trade would be confronted by the restoration of export trade and the modernisation of production methods. The strip mill, because of its technical superiority, had come to stay. West Wales must press for the establishment in the area of any proposed new plant.

The Government
requests all Managements—
in the National interest—to
Save Fuel
Coal, Coke, Gas & Fuel Oil
are precious—
INSULATE
HEAT-GENERATING PLANTS IN EVERY INDUSTRY
with
AMBERLITE
INSULATING BRICKS
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General Refractories Ltd
Head Office: Genefax House, Sheffield, 10. Telephone: 31113 (6 lines)
FIREBRICKS · BASIC BRICKS · ACID RESISTING MATERIALS · PLASTICS
INSULATION · SILICA BRICKS · SILLIMANITE · SANDS · CEMENTS
G.P.161

CONTRACTS OPEN

The date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Belfast, February 25—Castings, bus and trolley-bus springs, for the Transport Dept. The Acting General Manager, Transport Department, Sandy Row, Belfast.

Belfast, February 24—Armour-clad compound-filled 6,000-volt switchgear; meters and instrument transformers; l.t. fuse units, house service cut-outs and house service connector boxes; static transformers; V.B. and P.I. cables and cast-iron joint boxes; bare hard-drawn high conductivity copper conductors; V.I.R. electric cables, wires and flexibles, etc., for the Town Council. The City Electrical Engineer and General Manager, East Bridge Street, Belfast.

Bromley, March 3—Castings, tools, etc., during the year ending March 31, 1944, for the Borough Council. Mr. Harold Cliffe, borough engineer, Municipal Offices, Bromley, Kent.

Brynmenyn, March 17—Iron castings for 12 months ending March 31, 1944, for the Ogmore and Garw Urban District Council. Mr. Albert H. Jenkins, engineer and surveyor, Council Offices, Brynmenyn, Glam.

Londonderry, March 1—Road metal, ironwork (cast and wrought), tools, fireclay pipes, transformers and kiosks, cables, etc., for 12 months, for the Town Council. Mr. J. C. Donnell, town clerk, Guildhall, Londonderry.

COMPANY NEWS

(Figures for previous year in brackets.)

Spencer (Melksham)—Dividend of 10% (same).

Clyde Crane & Booth—Dividend of 15% (same).

English Electric Company—Dividend for 1942 on the ordinary shares of 10% (same).

Foster Yates & Thom—Net profit, £58,657 (£24,739); dividend of 6% (5%); forward, £1,775 (£1,818).

Steel Developments—Profit for 1942, £4,571 (£4,513); final dividend of 3%, making 5½% for the year (same); forward, £5,458 (£5,307).

Tomlinsons (Rochdale)—Net profit to June 30 last, £4,828 (£1,275); one year's preference dividend to December 31, 1938, £565; tax reserve, £3,500 (nil); forward, £16,168 (£15,859).

Bullers—Net profit for the year ended July 31 last, after making provision for taxation, depreciation and war damage insurance, £27,956; preference dividend, £7,500; ordinary dividend of 7½%; forward, £20,828 (£20,532).

Shanks & Company—Profit for 1942, after taxation, £75,686 (£38,933); preference dividends, £4,664 (same); final ordinary dividend of 9½%, making 12½% (8%); to war contingency fund, £20,000 (£10,000); to pension fund, £10,000 (nil); forward, £59,646 (£54,874).

PERSONAL

LORD HANKEY has been elected an honorary member of the Institution of Electrical Engineers in appreciation of his services as chairman of the Scientific and Engineering Advisory Committees of the War Cabinet.

MR. ALLAN IVOR BAKER, a director of Baker Perkins, Limited, manufacturing engineers and iron, steel and brass founders, Westwood Works, Peterborough, has been elected to serve on the Council of the British Engineers' Association during the ensuing year.

MR. E. INGHAM, who has been technical representative of Hardypick, Limited, for the past four years, has been appointed resident mining engineer of the Mining Engineering Company, Limited, Worcester, in the Nottinghamshire, Derbyshire and Leicestershire area, and will commence his duties on March 1.

MR. A. TURNER, managing director of the Foundry & Engineering Company (West Bromwich), Limited, Sandwell Road, West Bromwich, has been appointed a magistrate for the County Borough of West Bromwich. He has served for 10 years on the local Council, and is chairman of several committees, including the Food Control. He is past-chairman of the West Bromwich Manufacturers' Association.

Wills

COCKBURN, NORMAN, of Edinburgh, ironfounder ...	£59,682
CREASE, T. E., of Datchet, a director of Michell Bearings, Limited	£24,731
BINGHAM, J. W., a director of the Sheffield Forge & Rolling Mills Company, Limited	£3,459
TOWNSEND, J. A., managing director of Hamilton Brown & Company, Limited, iron, tinplate and metal merchants, Leeds	£10,075

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Plant Equipment Company—£3,000. G. L. Mackover, 51, Greencroft Gardens, London, N.W.6, subscriber.

Associated Silicas—£10,000. G. B. Watson, B. Watson, W. Rust, and A. Crowson. C. Greenwood, 31, Priestgate, Peterboro', subscriber.

G. E. & L. V. Rich, 28, Nursery Close, Shirley, Croydon—Engineers, etc. £1,000. H. G. Brandon, A. E. Heath, and A. H. Greenwood.

C. A. Hill & Company, The Avenue, High Street, Hull—Iron, steel and machinery manufacturers and merchants, etc. £5,000. C. A. and C. S. Hill.

Skilton & West—To take over an engineering business carried on at East Street and Woodrolfe Road, Tollesbury. £5,000. R. L. Skilton, R. West, L. C. M. Worsp, S. C. Young, and C. Hardie.

Lee Guinness, 82, King William Street, London, E.C.4—To take over the business of general engineers carried on by the Hydro-Pulsator Company (formerly called the "Lee Guinness Hydro-Pulsator Company"). £5,000.

FOUNDRY

BLACKINGS

FOR IRON & STEEL FOUNDERS

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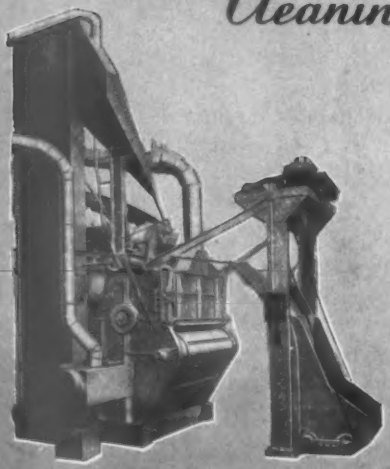

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